ICSE Board
Class X Physics
Board Paper Questions
Semester 1 -2021

Time: 1 hour **Maximum Marks: 40**

General Instructions:

You will not be allowed to write during the first 10 minutes.
This time is to be spent in reading the question paper.
ALL QUESTIONS ARE COMPULSORY
The intended marks for questions or parts of questions are given in brackets [].

Select the correct option for each of the following questions

Question 1.

The deviation produced by an equilateral prism does not depend on: [1]

(a) the angle of incidence.
(b) the size of the prism.
(c) the material of the prism.
(d) the colour of light used.

Question 2.

The refractive index of a diamond is 2.4. It means that: [1]

(a) the speed of light in vacuum is equal to $\frac{1}{2.4}$ times the speed of light in diamond
(b) the speed of light in the diamond is 2.4 times the speed of light in a vacuum.
(c) the speed of light in a vacuum is 2.4 times the speed of light in the diamond,
(d) the wavelength of light in diamond is 2.4 times the wavelength of light in vacuum.

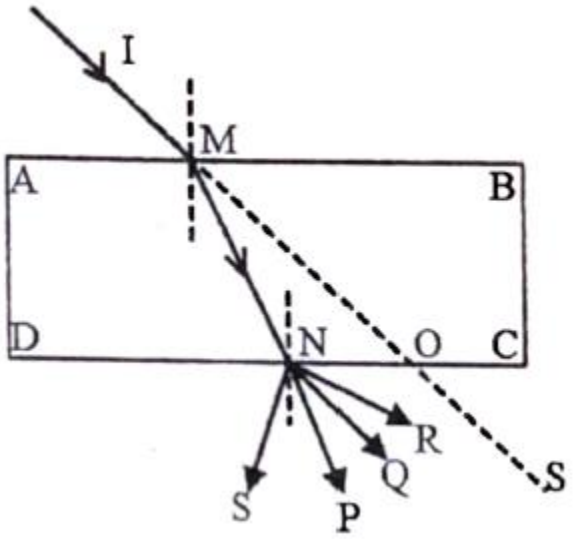
Question 3.

An object of height 10 cm is placed in front of a concave lens of focal length 20 cm at a distance 25 cm from the lens. Is it possible to capture this image on a screen? Select a correct option from the following: [1]

(a) Yes, as the image formed will be real.
(b) Yes, as the image formed will be erect.
(c) No, as the image formed will be virtual.
(d) No, as the image formed will be inverted.

Question 4.

A ray of light IM is incident on a glass slab ABCD as shown in the figure below. The emergent ray for this incident ray is: [1]



(a) NQ
(b) NR
(c) NP
(d) NS

Question 5.

The colour of white light which is deviated least by a prism is: [1]

(a) green
(b) yellow
(c) red
(d) violet

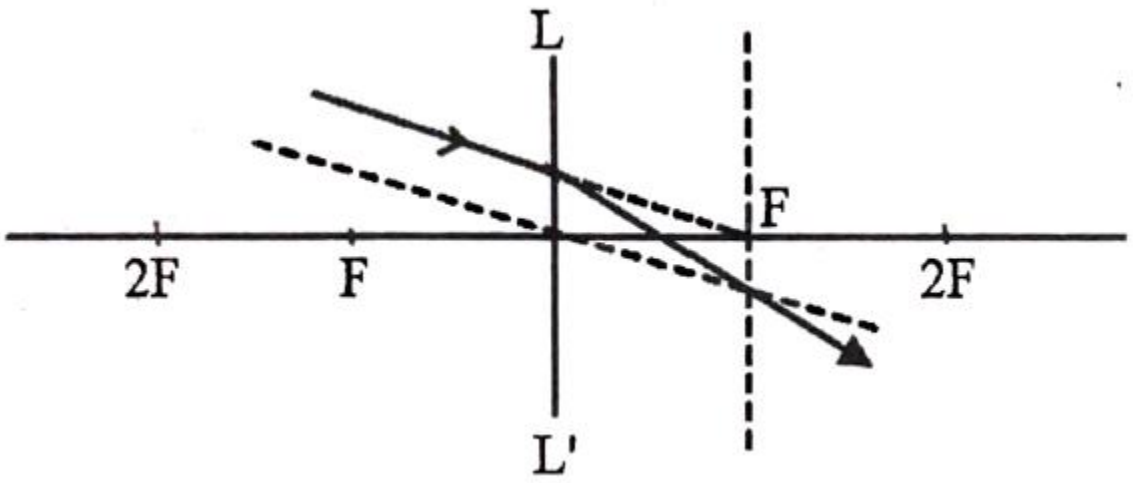
Question 6.

The wave length range of visible light is: [1]

(a) 40 nm to 80 nm
(b) 4000 nm to 8000 nm
(c) 4 nm to 8 nm
(d) 400 nm to 800 nm

Question 7.

Observe the diagram which shows the path of an incident ray through an optical plane LL" of a lens. The focal length of the lens is 20 cm.



(i) If an object is placed at a distance of 30 cm in front of this lens, then: [1]
(a) the image will be virtual
(b) the image will be diminished and inverted.
(c) the image will be diminished.
(d) the image will be real and magnified.

(ii) This type of lens can be used: [1]
(a) to correct hypermetropia.
(b) to correct myopia.
(c) to diverge light.
(d) in the front door peepholes.

(iii) An object is placed in front of this lens at a distance of 60 cm. Then the image distance from the lens with proper sign convention is: [1]
(a) +60 cm
(b) +30 cm
(c) -30 cm
(d) +15 cm

(iv) An object is placed in front of this lens at a distance of 60 cm. Then the magnification of the image is: [1]
(a) 0.25
(b) 1.25
(c) -0.5
(d) 1

Question 8.

The relation between CGS and S.I. unit of moment of force is: [1]
(a) 1 Nm= 10^5 dyne cm
(b) 1 Nm = 10^5 dyne
(c) 1 Nm= 10^7 dyne cm

(d) 1 dyne cm = 10^7 N m

Question 9.

A coolie raises a load upwards against the force of gravity then the work done by the load is: [1]

(a) zero.
(b) positive work.
(c) negative work.
(d) none of these.

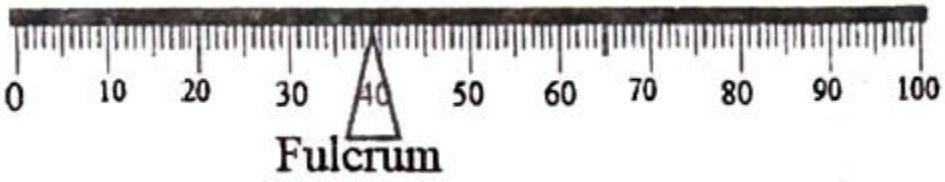
Question 10.

The energy change during photosynthesis in plants is: [1]

(a) heat to chemical.
(b) light to chemical.
(c) chemical to light.
(d) chemical to heat.

Question 11.

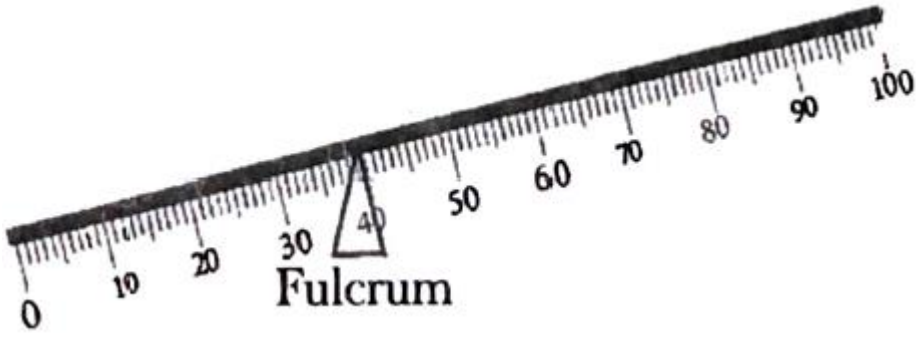
The diagram below shows the balanced position of a metre scale. [1]



Which one of the following diagrams shows the correct position of the scale when it is supported at the centre?

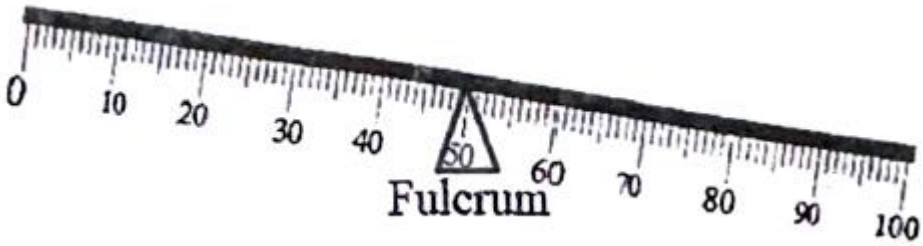
(a)

(b)



(c)

(d)



Question 12.

A stone tied at the end of a string is whirled by hand in a horizontal circle with uniform speed.

(i) Name the force required for this circular motion: [1]

(a) Centrifugal force.
(b) Centripetal force.
(c) Force of gravity.
(d) Frictional force.

(ii) What is the direction of the above-mentioned force? [1]

(a) Towards the centre of the circular path.
(b) Away from the centre of the circular path.
(c) Normal to the radius at a point where the body is present on the circular path.
(d) Direction of this force keeps on changing alternately towards and away from the centre.

Question 13.

A body of mass 200 g falls freely from a height of 15 m. [g = 10 ms^{-2}]

(i) When the body reaches 10 m above the ground, its potential energy will be: [1]

(a) 20000 J
(b) 10 J
(c) 10000 J
(d) 20 J

(ii) The gain in kinetic energy of the body when it reaches 10 m above the ground is: [1]

(a) 20 J
(b) 10 J
(c) 30 J
(d) 25 J

(iii) The total mechanical energy it will possess, when it is just about to strike the ground is: [1]

(a) 30000 J
(b) 20000 J
(c) 30 J
(d) 20 J

(iv) The velocity in ms^{-1} with which the body will hit the ground is: [1]

(a) 30
(b) 10
(c) $10\sqrt{3}$
(d) $10\sqrt{2}$

Question 14.

A woman draws water from a well using a fixed pulley. The mass of the bucket and the water together is 10 kg. The force applied by the woman is 200 N. The mechanical advantage is ($g = 10\ m/s^2$): [1]

(a) 2
(b) 20
(c) 0.05
(d) 0.5

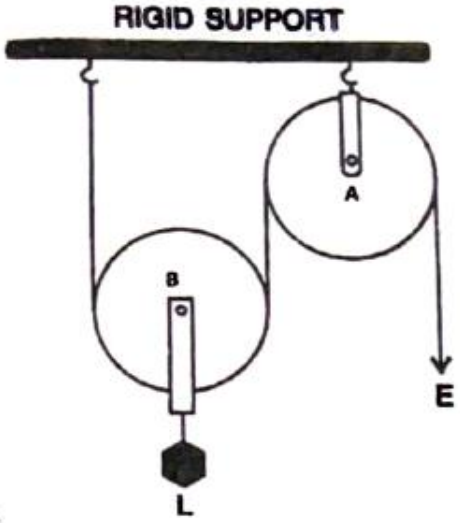
Question 15.

A single fixed pulley is used because: [1]

(a) it changes the direction of applied effort conveniently.
(b) it multiplies speed.
(c) it multiplies effort.
(d) its efficiency is 100%.

Question 16.

In the diagram shown below, the velocity ratio of the arrangement is: [1]



(a) 1
(b) 2
(c) 3
(d) 0

Question 17.

Which one of the following is the correct mathematical relation? [1]

(a) Power = Force/ Velocity
(b) Power = Force x Acceleration
(c) Power Force/ Acceleration
(d) Power= Force x Velocity

Question 18.

Select a correct option with respect to echo depth sounding: [1]

(a) infrasonic waves are used
(b) the frequency of the waves used is between 20 Hz and 20,000 Hz.
(c) ultrasonic waves are used.
(d) supersonic waves are used.

Question 19.

Which one of the following diagnostic methods use reflection of sound? [1]

(a) CT scan
(b) Electrocardiogram
(c) Echo cardiogram
(d) MRI

Question 20.

A boy standing in front of a wall produces two whistles per second. He notices that the sound of his whistling coincides with the echo. The echo is heard only once when whistling is stopped. Calculate the distance between the boy and the wall. (The speed of sound in air = 320 m/s)

(i) The time in which the boy hears the echo is: [1]
    (a) 1s
    (b) 0.5 s
    (c) 1.5s
    (d) 2s

(ii) The distance at which the boy is standing from the wall: [1]
    (a) 160 m
    (b) 240 m
    (c) 320 m
    (d) 80 m

(iii) If the speed of sound is increased by 16 ms^{-1} and the boy moves 4 m away from the wall then in how much time will he hear the echo of the first whistle? [1]

(a) 0.525 s
(b) 0.5 s
(c) 0.48 s
(d) 0.3 s

(iv) In which of the following timings of reflection of the whistle, the echo cannot be heard? [1]

(a) 0.05 s
(b) 0.12 s
(c) 0.2 s
(d) 0.11 s

Question 21.

The ratio of velocities of light of wavelength 400 nm and 800 nm in a vacuum is: [1]

(a) 1:1
(b) 1:2
(c) 2:1
(d) 1:3

Question 22.

1 joule= _____ erg [1]

(a) 10^9
(b) 10^7
(c) 10^5
(d) 10^6

Question 23.

A light body A and a heavy body B have the same momentum.

(i) Choose a correct statement from the given options. [1]

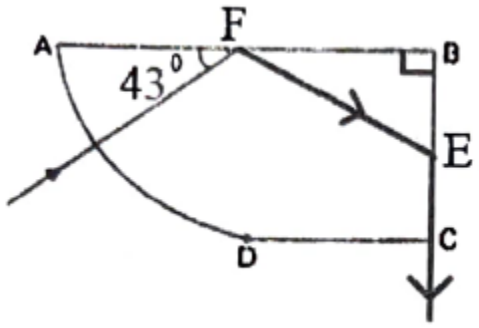
(a) kinetic energy of body A and body B will be the same.
(b) kinetic energy of body A is greater than kinetic energy of body B.
(c) kinetic energy of body B is greater than kinetic energy of body A.
(d) unless we know the velocity, we cannot find which body has greater kinetic energy.

(ii) If the ratio of kinetic energies of **A** and **B** is 5:2 then which one of the following gives the mass ratio of the bodies respectively? [1]

(a) 5 : 2
(b) 25 : 4
(c) 2 : 5
(d) 4 : 24

Question 24.

The diagram below shows a ray of light travelling from air into a glass material as shown below. Answer the questions that follow:



(i) The angle of incidence at the surface AB is: [1]

(a) 43°
(b) 47°
(c) 90°
(d) 0°

(ii) Select a correct statement from the following. [1]

(a) The speed of light at the curved surface AD does not change while entering the block.
(b) The ray at the surface AD is not travelling along the radius of the curved part
(c) The ray at the surface AD is travelling along the radius of the curved part.
(d) Light never refracts when it enters a curved surface.

(iii) The angle of incidence on the surface BC is: [1]

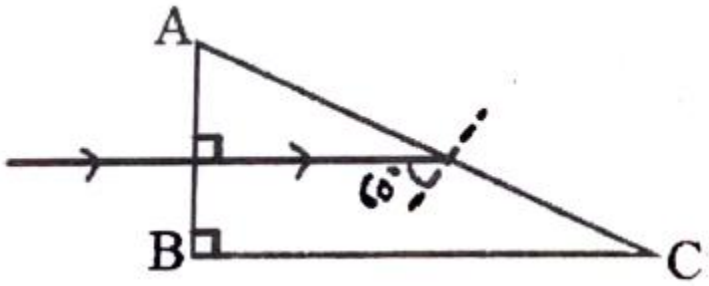
(a) 43°
(b) 47°
(c) 90°
(d) 0°

(iv) The critical angle of this material of glass: [1]

(a) 47°
(b) 43°
(b) 42°
(c) 45°

Question 25.

The diagram below shows the path of light passing through a right-angled prism of critical angle 42°



(i) The angle C of the prism is: [1]

(a) 45^o

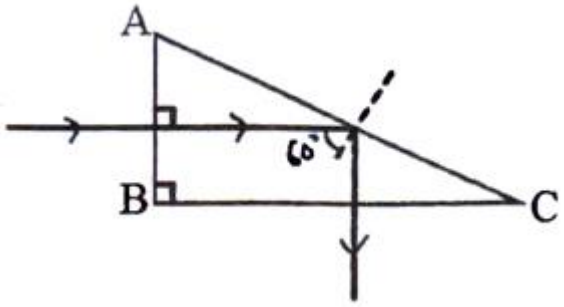
(b) 60^o

(c) 90^o

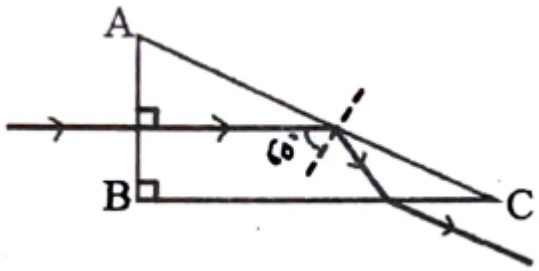
(d) 30^o

(ii) Which one of the following diagrams shows the correct path of this ray till it emerges out of the prism? [1]

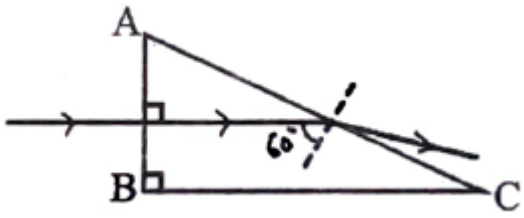
(a)



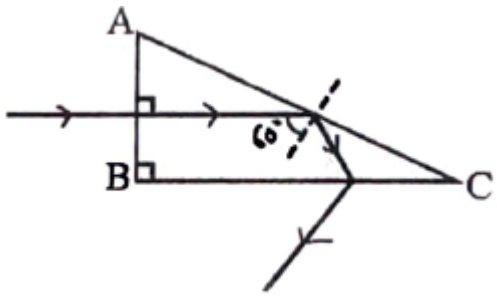
(b)



(c)



(d)



Solution

Solution 1 Correct option – b) size of prism

The deviation produced by an equilateral prism does not depend on size of prism.

Solution 2 Correct option – c) the speed of light in vacuum is 2.4 times the speed of light in the diamond.

Refractive index,

$$\mu_{diamond} = \frac{\mu_{diamond}}{\mu_{air}} = \frac{c}{v_{diamond}} = 2.4$$

where, c – velocity of light in air/vacuum

Thus,

$$c = 2.4 \times v_{diamond}$$

Thus, the speed of light in a vacuum is 2.4 times the speed of light in the diamond.

Solution 3 Correct option – c) No, as the image formed will be virtual.

As the lens used is concave lens, the image formed will be virtual and erect and such images cannot be obtained on the screen.

Solution 4 Correct option – a) NQ

The light ray MS is extension of incident ray IM.

When light ray is coming out from the denser medium into rarer medium the emergent ray for glass slab is parallel to that of incident ray and it bends towards the normal. The only ray which is satisfying both the condition is ray NQ.

Solution 5 Correct option – c) red

The colour of white light which is deviated least by a prism is red.

Solution 6 Correct option – d) 400 nm to 800 nm

The wavelength range of visible light is 400 nm to 800 nm.

Solution 7

i) Correct option – d) the image will be real and magnified

It is given that after refracting the rays of light are converging at point to right side of lens. The object is placed at 30 cm and focal length of lens is 20 cm. This means as the rays are converging the lens is convex lens and object is placed between 2F and F. Thus, the image formed will be real and magnified.

ii) Correct option – a) to correct hypermetropia

The lens used is convex lens. The explanation for the same is given in 7 (i). Convex lens is used to correct hypermetropia.

iii) Correct option – b) +30 cm

When the object is placed at 60 cm to left side of convex lens of focal length 20 cm, it means that the object is placed beyond 2F. And when the object is placed beyond 2F of convex lens the image formed will be between F and 2F (i.e., between + 20 cm and + 40 cm) to the right side. Thus, the sign according to New Cartesian sign convention will be positive for the image distance. The only valid option satisfying all these conditions is + 30 cm.

iv) Correct option – c) – 0.5

As the image formed in this case will be real and inverted the sign to the value of the height of image should be negative according to New Cartesian sign convention. And as the object is placed beyond 2F the image formed will be diminished. This means the image formed will be less than 1. The value satisfying both the conditions is – 0.5

Solution 8 Correct option – c) 1 Nm = 10^7 dyne cm

Moment of force = Force x perpendicular distance from line of action

Thus, SI unit of moment of force is Nm and SI unit is dyne cm.

1 N = 10^5 dyne

1 m = 100 cm

Thus, 1 Nm = 10^7 dyne cm

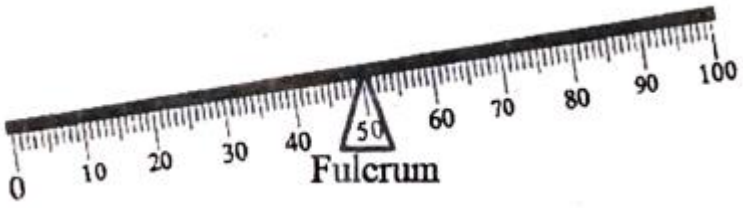
Solution 9 Correct option – c) negative work

The coolie has raised the load in upward direction i.e., displacement is in opposite direction to that of force of gravity and when this is the case the work done by load is negative. Thus, a negative work is done.

Solution 10 Correct option – b) light to chemical

The energy change during photosynthesis in plants is light energy to chemical energy.

Solution 11 Correct option – a)



As given in the question we can see that when the fulcrum is at 40 cm the left arm and right arm both are in balanced position. So, when the fulcrum is moved to the centre of scale which is 50 cm (i.e., to the right side of the scale) the left side will weigh more than right and thus, left side will move in downward direction. Thus, correct option is a)

Solution 12

i) Correct option – b) centripetal force

A stone tied at end of a string is whirled by hand in a horizontal circle with uniform speed. The force required for this circular motion is centripetal force.

ii) Correct option – a) towards the centre of the circular path
In the given case, the direction of force is towards the centre of the circular path.

Solution 13
i) Correct option – d) 20 J
The potential energy is given as,
P.E. = mgh
M = 200 g = 0.2 kg
g = 10 m/s^2 (given), h = 10 m
P.E. = 0.2 × 10 × 10 = 20 J

ii) Correct option – b) 10 J
The potential energy at the highest point in this case, 15 m is
P.E. = mgh = 0.2 x 15 x 10 = 30 J
Potential energy at height 15 m is maximum and the kinetic energy is zero.
When body reaches 10 m, the potential energy become 20 J
According to law of conservation of energy, the kinetic energy at 10 m height will be
P.E. at height 15 m – P.E. at height 10 m = Gain in K.E. = 30 J – 20 J = 10 J
Thus, gain in K.E. until it reaches 10 m above ground is = 10 J

iii) Correct option – c) 30 J
The total energy at highest point i.e., 15 m is 30 J
According to law of conservation of energy the total energy at any point of its journey during this freefall will remain same.
Thus, total energy of body when it is about to strike ground is 30 J.
iv) Correct option – c) $10\sqrt{3}$
When the body will hit the ground the kinetic energy of this body will be maximum.
This means Kinetic energy at ground will be 30 J
We know,
K.E. = ½ mv^2

$$30 = \frac{1}{2} \times 0.2 \times v^2$$

$$v^2 = \frac{30 \times 2}{0.2} = 300$$

$$v = \sqrt{300} = \sqrt{3 \times 100} = \sqrt{3 \times 25 \times 4} = 10\sqrt{3}$$

Thus, velocity of the body with which it will hit the ground is $10\sqrt{3}$ m/s

Solution 14 Correct option – d) 0.5
Load = 10 kgf = 100 N
Effort = 200 N
We know,
Mechanical advantage = Load/ Effort = 100/200 = 0.5

Solution 15 Correct option – a) it changes the direction of applied effort conveniently
A single fixed pulley is used because it changes the direction of applied effort conveniently.

Solution 16 Correct option – b) 2
The velocity ratio of the arrangements of the pulley in which one is fixed and another one is movable is 2.

Solution 17 Correct option – d) Power = Force × velocity
Power = Force x velocity is the correct mathematical relation.

Solution 18 Correct option – c) ultrasonic waves are used
In echo depth sounding, ultrasonic waves are used.

Solution 19 Correct option – c) Echo cardiogram
The diagnostic method which uses reflection of sound is echo cardiogram.

Solution 20

i) Correct option – b) 0.5 s
The boy blows two whistles per second. That means time taken for one whistle is 0.5 s. The sound of whistling coincide with the echo and echo is heard only when whistling is stopped. This means the time in which the boy hears echo will be 0.5 s

ii) Correct option – d) 80 m
We know,
$d = (v \times t)/ 2 = (320 \times 0.5)/2 = 160/2 = 80$ m

iii) Correct option – b) 0.5 s
When the speed of sound is increased by 16 m/s. The new speed becomes 336 m/s
The boy moves 4 m away from the wall i.e., now he will be standing 84 m away from the wall.
We know,
$d = (v \times t)/2$
$84 = (320 \times t)/2$
$84 = (336 \times t)/ 2$
$t = (84 \times 2)/336 = 0.5$ s

iv) Correct option – a) 0.05 s
For the echo to be heard the minimum time must be $1/10^{th}$ of the second i.e., 0.1 of second. So, the echo cannot be heard at 0.05 s.

Solution 21 Correct option – a) 1:1
When the light is travelling in a vacuum, the velocity of light of any wavelength is same. Thus, ratio of velocities of light of wavelength 400nm and 800 nm in a vacuum is 1:1.

Solution 22 Correct option – b) 10^7

1 Joule = 10^7 erg

Solution 23

i) Correct answer – b) Kinetic energy of body A is greater than kinetic energy of body B

Given that,

Momentum of body A, p_A =Momentum of body B, p_B

Mass of body A, m_A < Mass of body B, m_B

Hence the ratio of kinetic energy of body A and B are

$$\frac{K.E_A}{K.E_B} = \frac{\frac{p_A^2}{2m_A}}{\frac{p_B^2}{2m_B}} = \frac{m_B}{m_A}$$

$$\frac{K.E_A}{K.E_B} > 1 \ldots (\because \frac{m_B}{m_A} > 1)$$

$$\therefore K.E_A > K.E_B$$

Hence we can conclude that, kinetic energy of body A is greater than kinetic energy of body B

ii) Correct answer – c) 2:5

Given that,

$$\frac{K.E_A}{K.E_B} = \frac{5}{2}$$

Now we know the relation between kinetic energy and mass of body and it can be expressed as

$$\frac{K.E_A}{K.E_B} = \frac{\frac{p_A^2}{2m_A}}{\frac{p_B^2}{2m_B}} = \frac{m_B}{m_A}$$

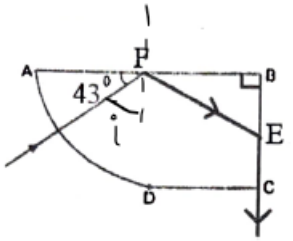
$$\therefore \frac{m_B}{m_A} = \frac{5}{2} \Rightarrow \frac{m_A}{m_B} = 2:5$$

Solution 24

i) Correct option – b) 47°

From the given figure we can see that angle of incidence i.e., the angle between incident ray and normal is 47° along surface AB as we can see below.

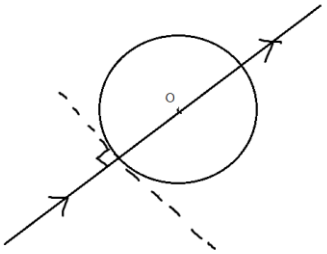
Hence the angle of incidence at surface AB is 47° (i.e., AB =90° - 43°).



ii) Correct option –c) The ray at the surface AD is travelling along the radius of curved part.

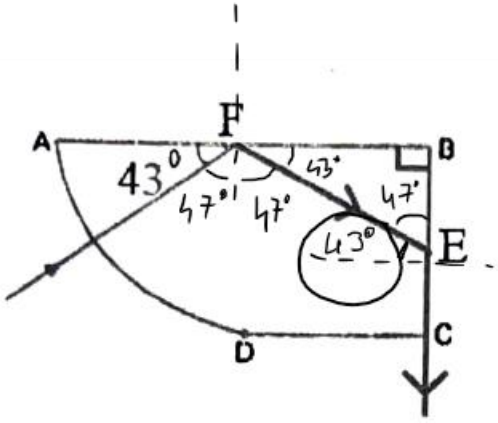
For the given case we know that light is incident on a curved surface of glass material.

Hence the ray will be travelling along the radius of curvature since light incident perpendicular to curved surface will always travel towards its centre as shown below.

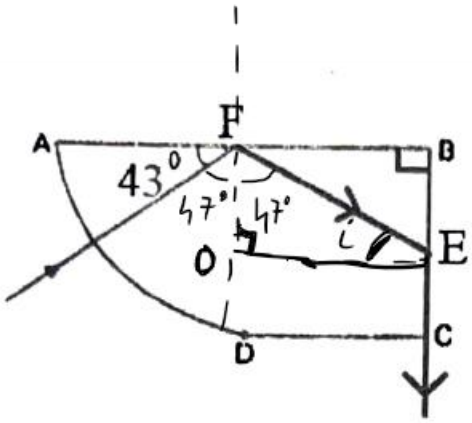


iii) Correct option – a) 43°

From the given figure we can see that angle of incidence along surface BC will be 43° as we can see below.



Alternate method:



Here for triangle FOE the angle of incidence i will be given as we can see below.

$\angle i = 180 - 47 - 90 = 43°$

iv) Correct option – a) 43°

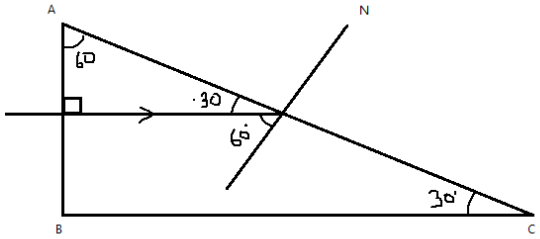
As we can see from the given figure, when angle of incidence at surface BC is 43° the light ray becomes parallel to surface BC.

Hence for the given case the angle of incidence is 43°.

Solution 25

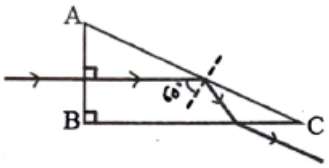
i) Correct option – d) 30°

From the given figure we can see that angle between incident ray and normal across surface AC is 60°. Using this we can predict that angle A will be 30° and angle C will be 60° by using triangle sum theorem (i.e., ∠A+ ∠B+ ∠C=180°).



Hence the angle C of given prism will be 30°.

ii) Correct option – b)



From the given data we know that, critical angle of prism is 42° and angle of incidence is 60°.

Thus, from this we can conclude that option c is incorrect since incident angle is greater than critical angle (i.e., $\angle i > \angle i_c$) which means light will undergo total internal reflection.

And from this given figure we can conclude that only option b is correct since for option a incident angle is not equal to reflected ray and for option d light ray after refracting from surface BC will bend away from normal not toward normal ($\because \mu_g > \mu_{air}$).